New challenges for electric utilities with special focus on power management.

DF 68 — LCA of key technologies for future electricity supply

Dr. Britta Heimbach

Ein Unternehmen der Stadt Zürich

ewz

Agenda.

- Introduction
- Project Future Distribution Grid
- Case Study Electromobility
- Discussion and Outlook

Introduction.

ewz Power Grid.

Motivation.

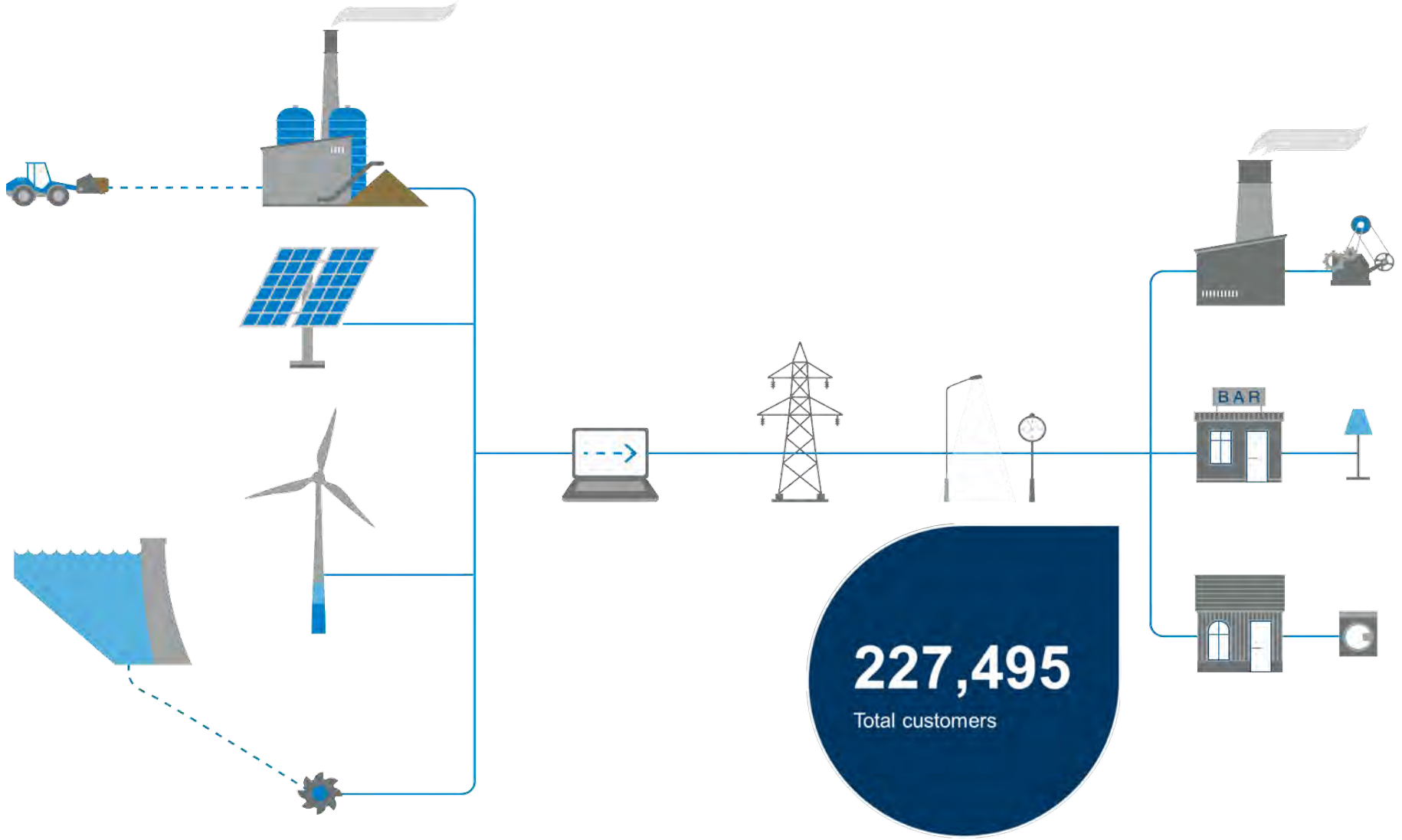
Vision Future
Distribution Grid.

Key figures.

Business year 2016	
Overall performance	CHF 859 million
Earnings before interest and taxes (EBIT)	CHF 68,2 million
Net result	CHF 68,5 million
Power production	4,827 GWh (ewz power plants/investments)
Our power plants	▪ 15 hydropower ▪ 7 wind farms ▪ 1 fuel cells
Residential customers	about 202,565
Commercial and business customers	about 24,930
Employees	1,189 (including 225 women)

More details Annual and Sustainability Report 2016

From the power plant to the socket.

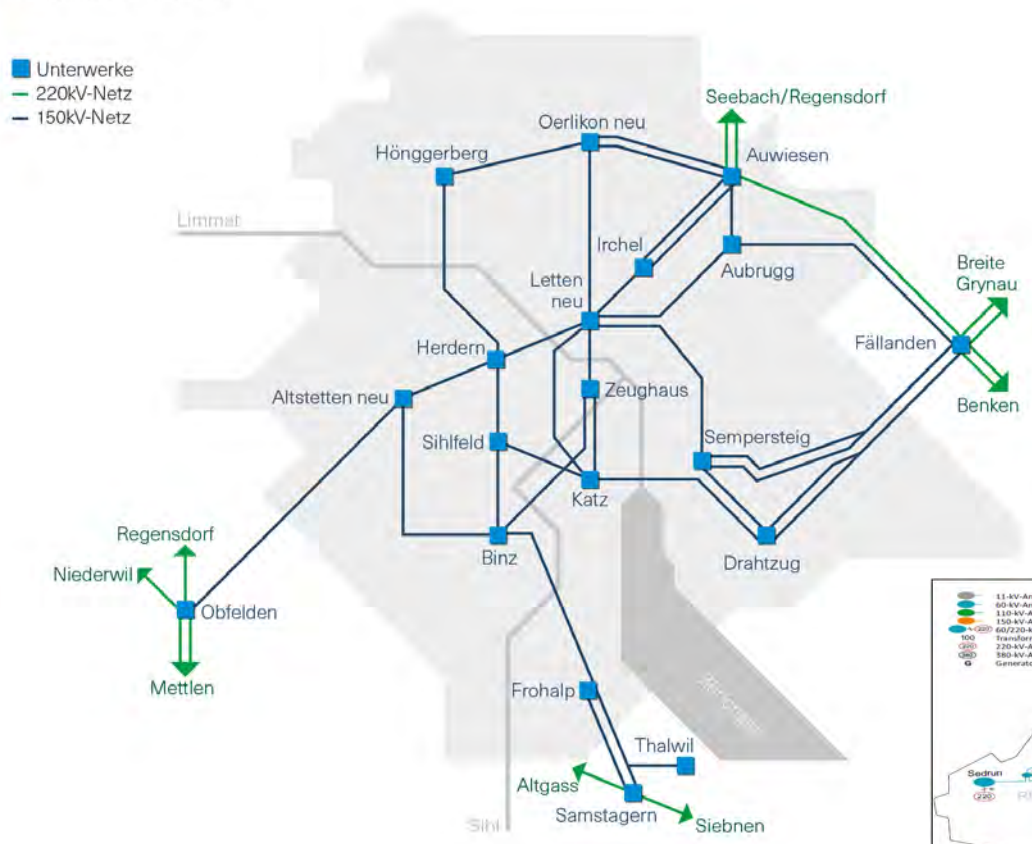


Power production

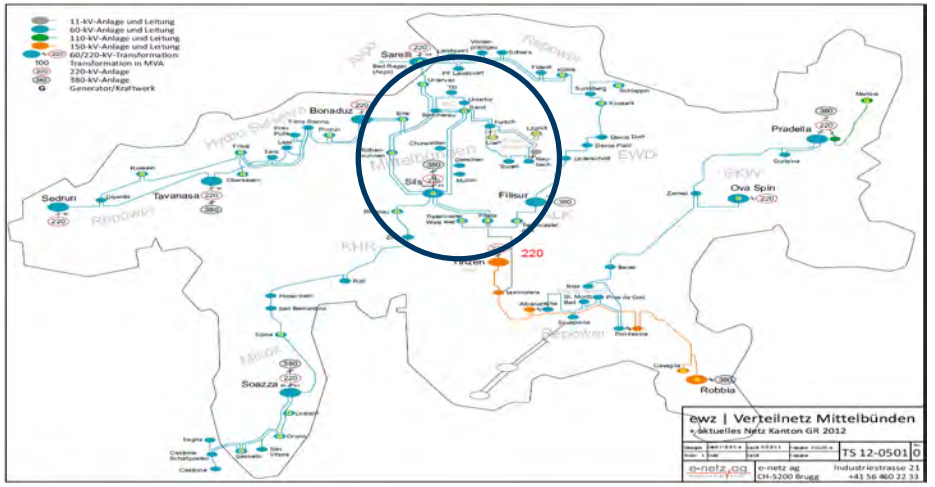
Trading and transportation

Distribution

Distribution Grid Zurich & Grisons.



Overhead lines	**413 km**
Cable	**5168 km**
Substations	**30**
Transformer stations	**882**



Motivation.

2000-Watt Society for Zurich in 2100

Energy Strategy 2050

Renewable energies and mobility

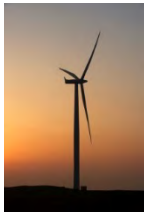
Long-term distribution grid planning

- Load growth and new supply areas
- Large increase of renewable production

Distribution grid has to fulfil future needs

- Volatile and decentralized production
- Bi-directional power flow

Greening the Grid.

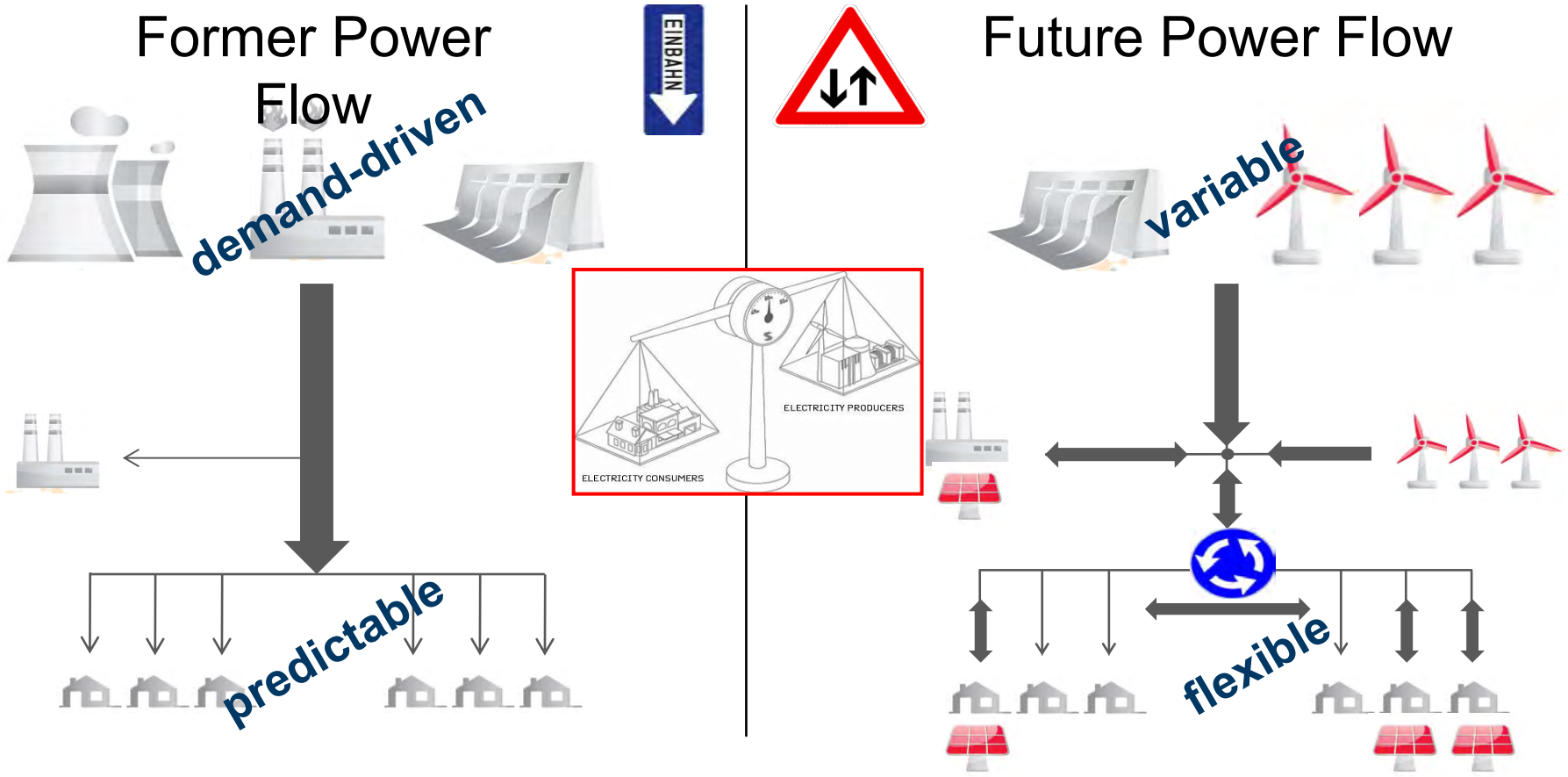


Electrification, decentralization, and digitalisation

Many new challenges and opportunities

New planning approaches are necessary

Need for flexibility increases.



Project Future Distribution Grid for the City of Zurich.

Scenarios 2050.

Modelling Grid Development.

Results and Conclusion.

Key Factors.


Renewable energies
Load development
Load management
Local storage
Electro-mobility
Power quality

Scenarios 2050.

Characteristics in 2050	WEBI «Business as usual»	REAL «Realistic»	NAUX «Sustainable and flexible»	EXNA «Extremly sustainable»	Reference scenario
New renewables	Moderate 500 MW_{eff}	High 800 MW_{eff}	High 800 MW_{eff}	Extremly High 1500 MW_{eff}	High 600 MW_{eff}
Decentralized storage (% of PV capacity)	0%	70%	70%	70%	30%
Load development (without electromobility)	800 MW	800 MW	520 MW	520 MW	800 MW
Electromobility (with load management)	10%	60%	90%	90%	90%
Load management (IoT, EMS, WP,…)	Potential 40 MW (Status quo)	55 MW	70 MW	70 MW	70 MW
Quality of supply	SAIDI < 10 min	SAIDI 5-10 min	SAIDI 5-15 min	SAIDI 5-15 min	SAIDI 5-15 min

Modelling Grid Development.

Grid Expansion Model

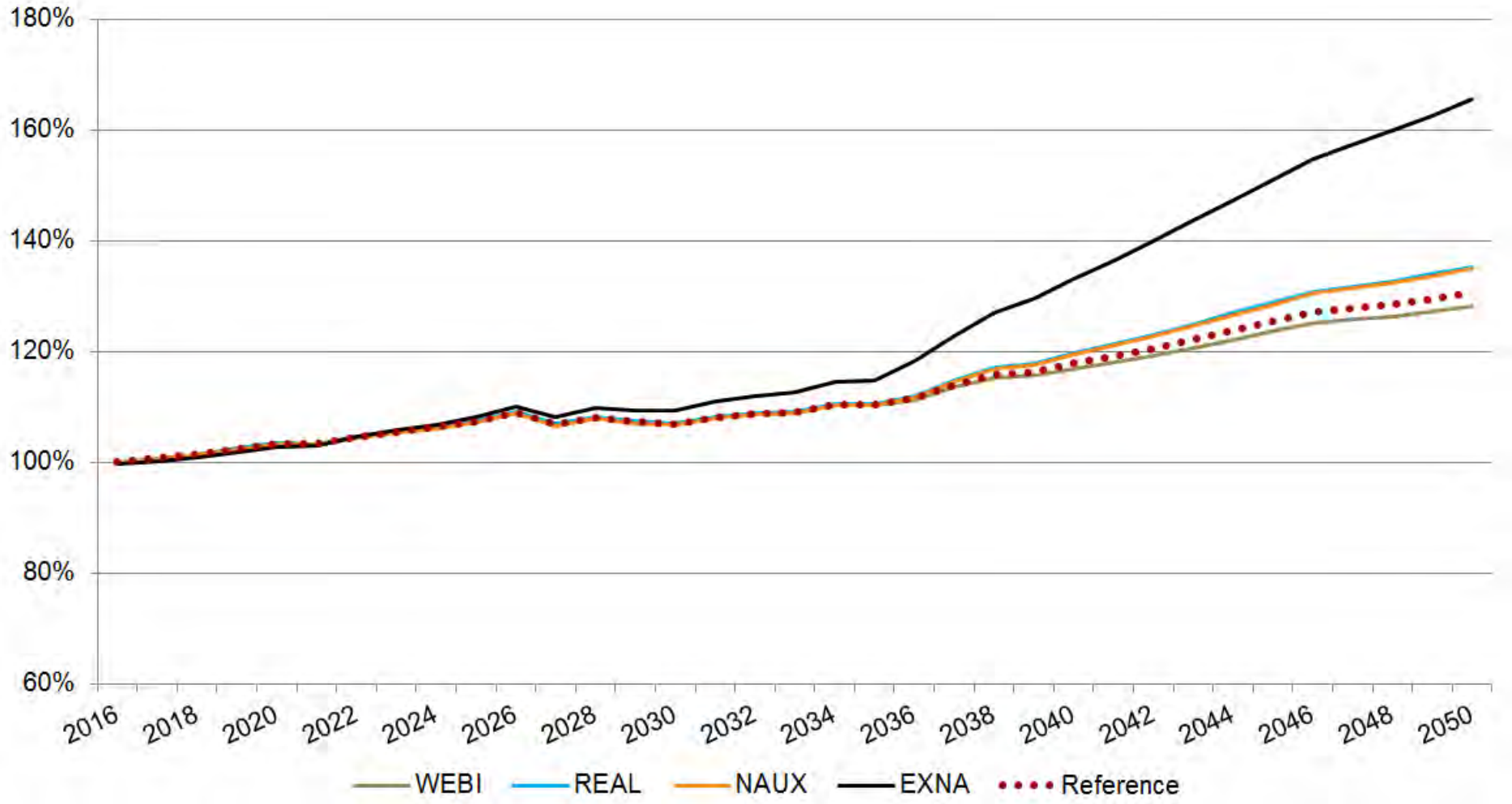
- Load flow and capacity calculations
- Replacement due to age
- Statistical clustering of characteristic subgrids in LV level

Distribution Grid Development

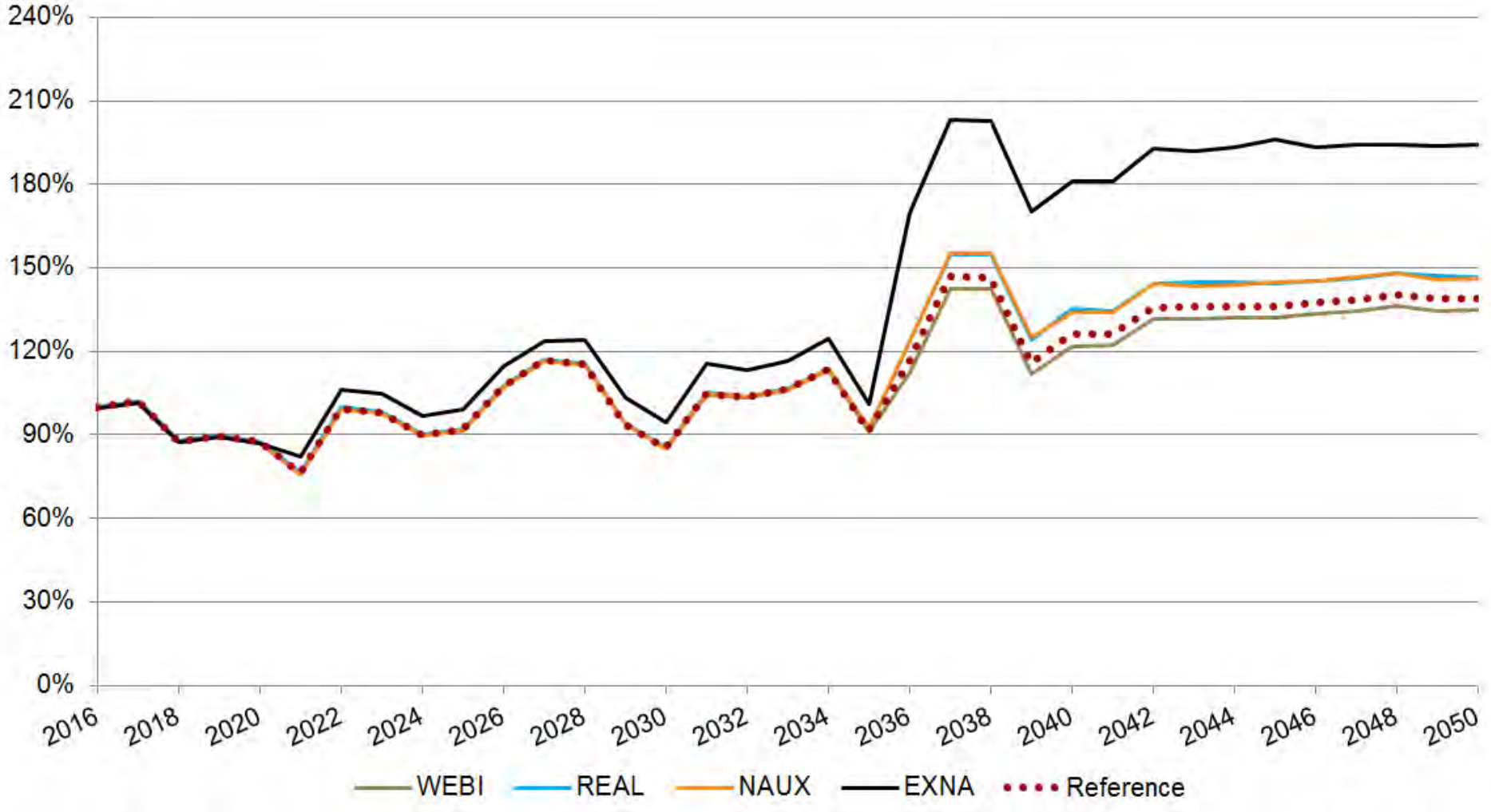
New Technology Model

- Simplified parametric approach
- Small set of input parameters
- Focus of analysis is LV subgrid

Estimation of total cost of capital.



Estimation of total investment costs.



Results Project Future Distribution Grid.

- Load growth due to increasing population and electrification will be the main drivers for grid development in the near future.
- Grid development is expected to be driven by PV after 2035 for all scenarios.
- Charging of electric vehicles might cause challenges much earlier.
- New technologies can be employed to temporally postpone and/or reduce grid expansion.
- Changes in the general framework can influence the overall development within a short time span.
- Examples: New regulation scheme or the IoT.

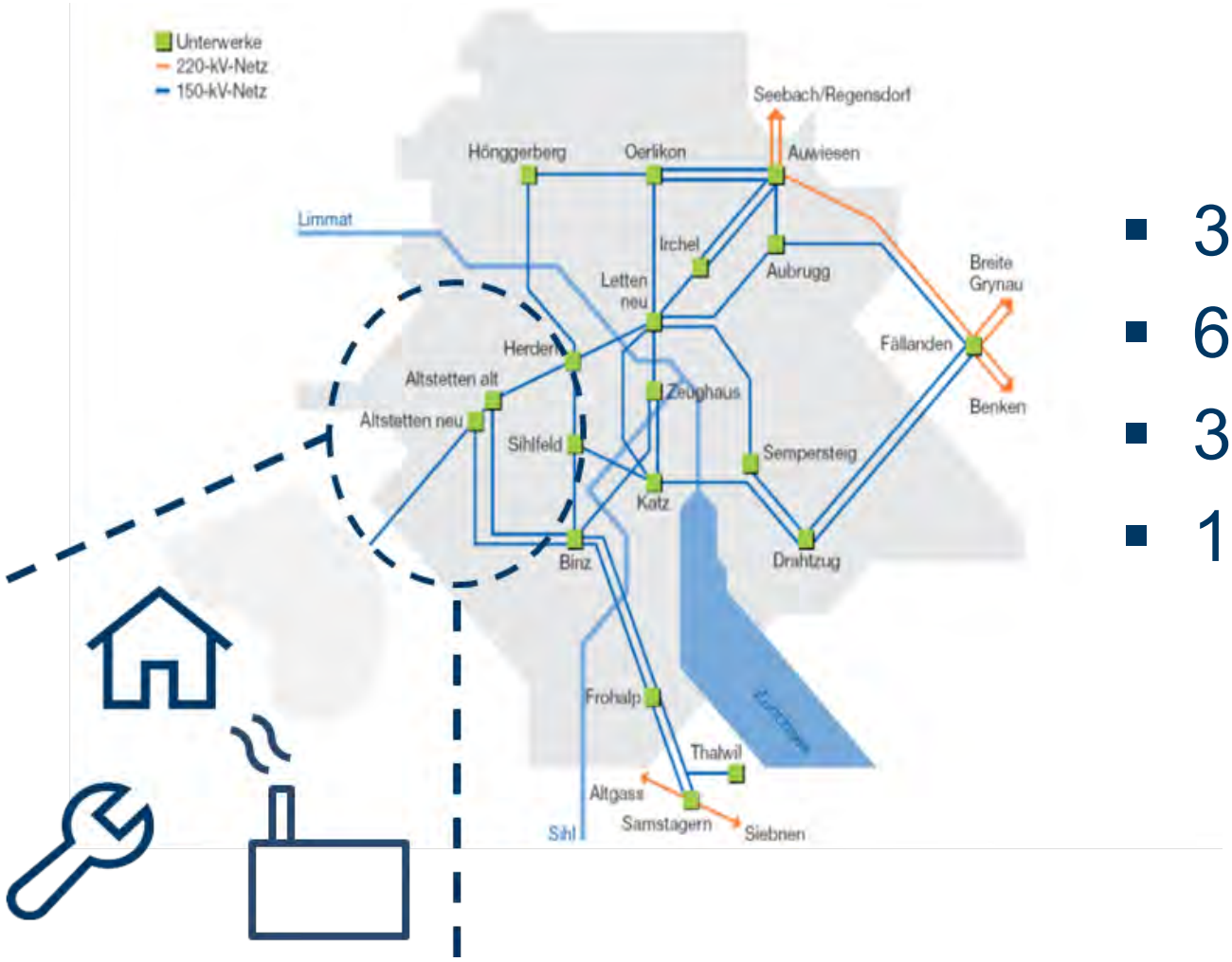
Case Study Electromobility.

Framework.

Measures.

Results and Conclusion.

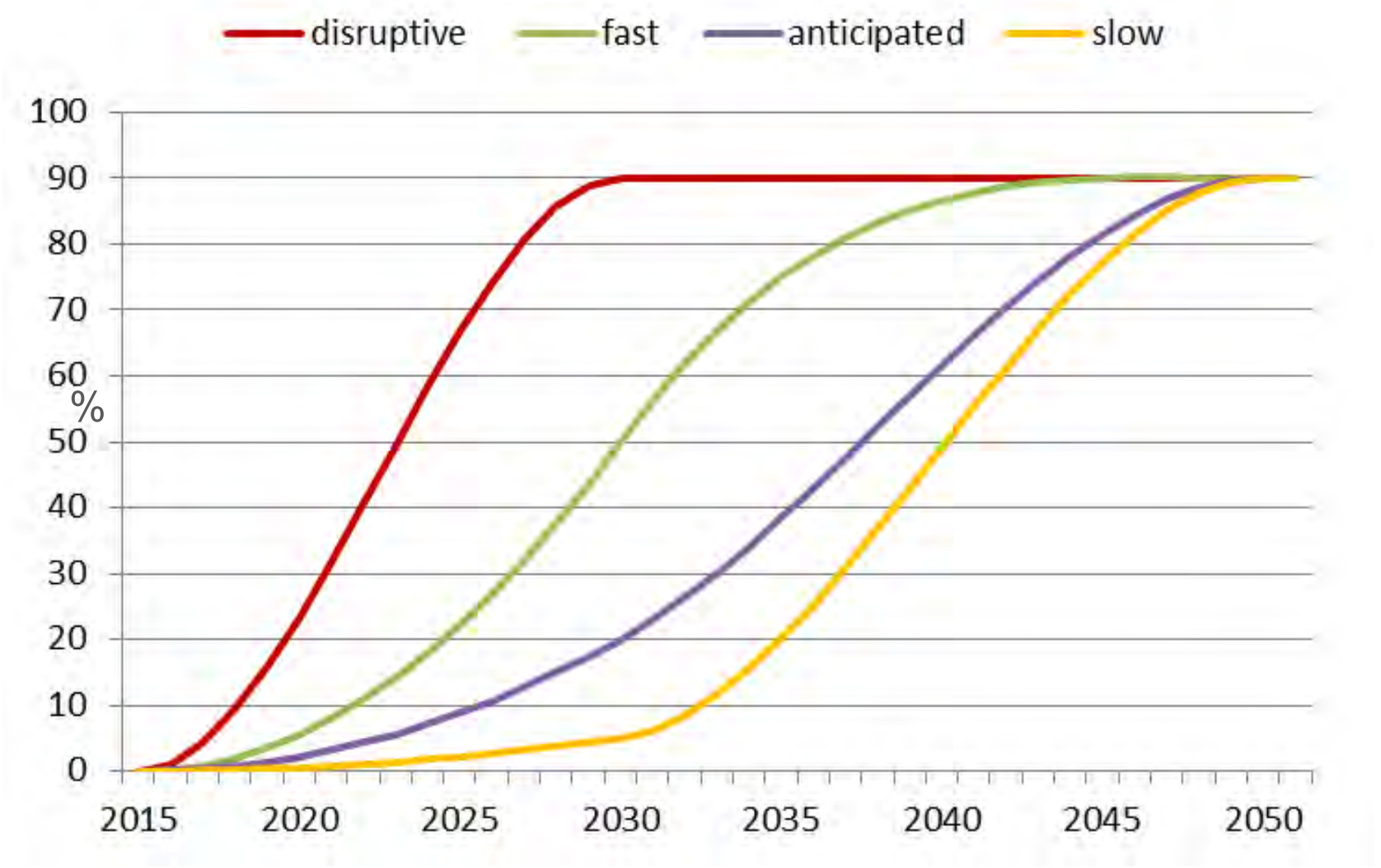
Subgrid.



- 35’000 customers
- 65 MW maximal load
- 37 photovoltaic units
- 1600 kWp installed

Paths to Electromobility.

Reference scenario: 90% electromobility in 2050.

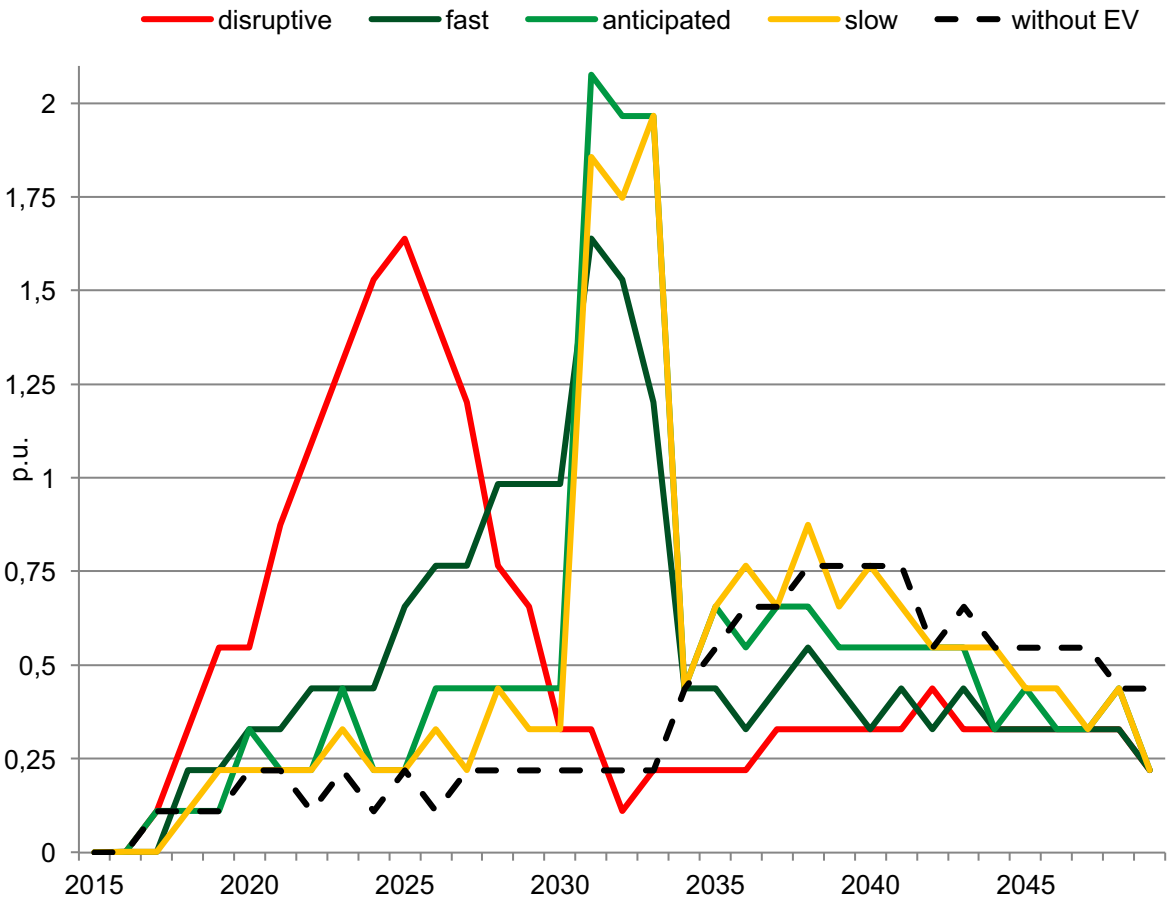


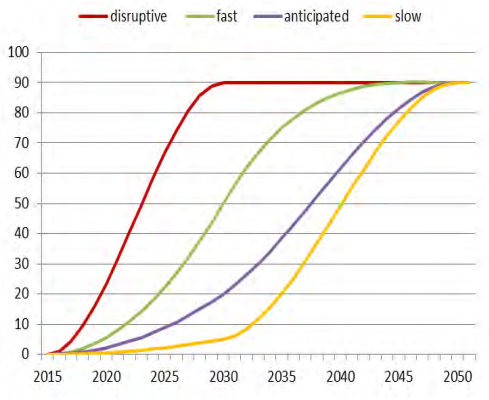
Measures.

- Grid expansion

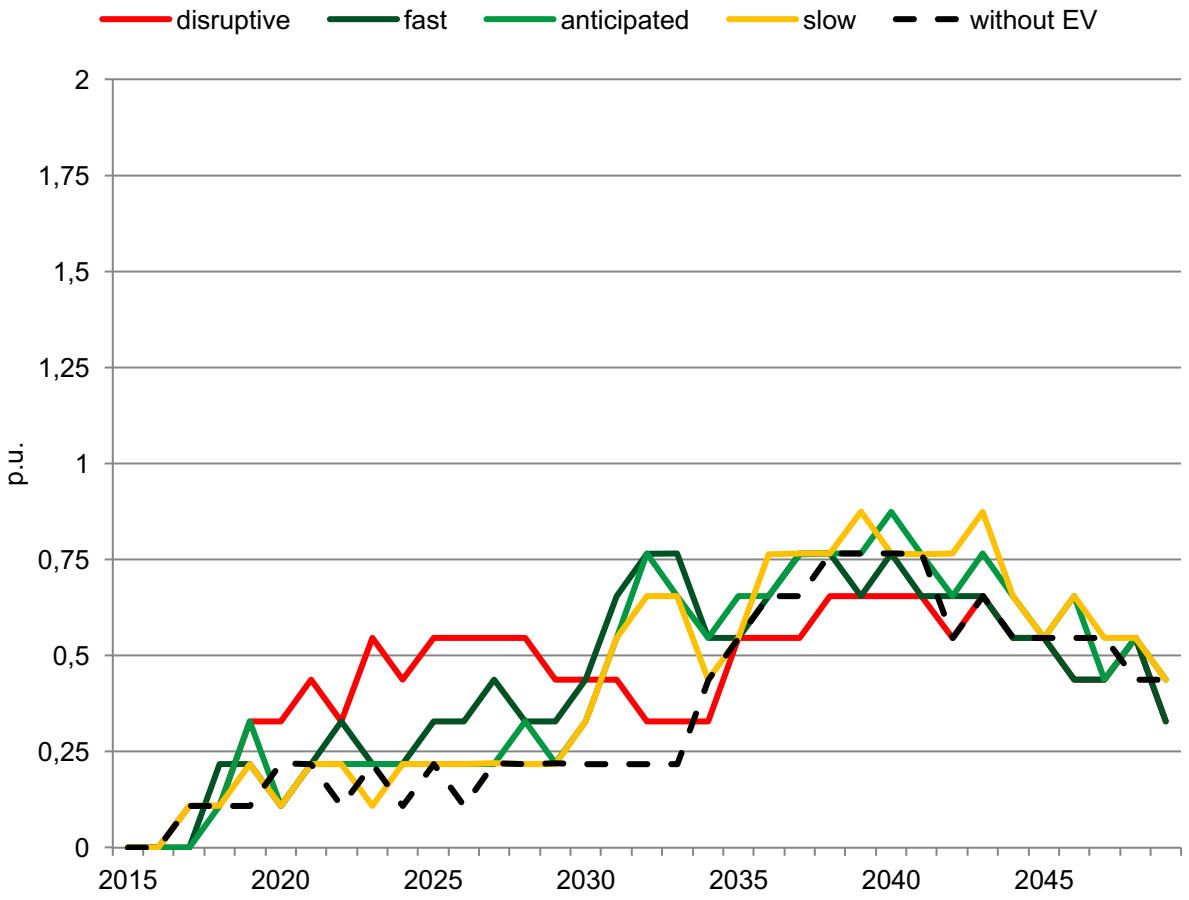
- Power management
  Intelligent charging for EVs in car parks to avoid simultaneous charging in order to shave peaks.

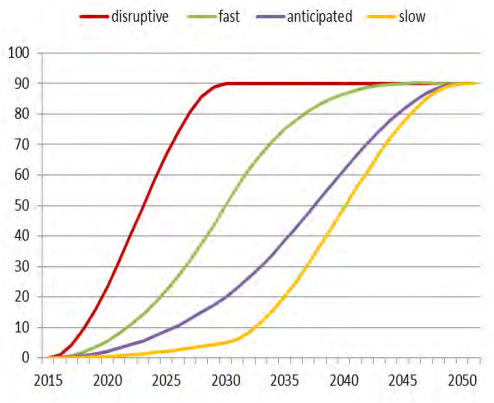
Yearly grid expansion costs due to load and electromobility growth without intelligent EV charging.





Yearly grid expansion costs due to load and electromobility growth with intelligent EV charging.





Conclusion Case Study Electromobility.

- Even a small penetration of electric vehicles causes significant grid expansion costs.
- The costs without intelligent load management are much higher in all scenarios.
- Applying intelligent charging we can manage power in order to achieve a more efficient distribution grid.

Discussion and Outlook.

Flexibility is Key to the Future.

Flexibility is Key to the Future.

The main drivers for the development of the grid until 2050:

- The energy transition and integration of decentralized renewables.
- The electrification of the mobility and the heating sector.
- New active role of the customers/prosumers.
- Digitalization developments, as the IoT, and technology leaps could lead to disruptive changes in the distribution grid.

Flexibility is Key to the Future.

The solution for the operation of a reliable and efficient grid, that fulfil the needs of the customers of the future:

- Grid expansion as well as smart-grid technologies will be needed.
- Power management and usage of flexibilities will play an important role.
- Smart metering and grid monitoring will be an important part of the future grid.
- Agile planning methods with shorter planning intervals are necessary, in order to reduce investment risks.

Thanks
for your attention!

Questions?

Dr. Britta Heimbach

Team Manager
Grid Development
britta.heimbach@ewz.ch
+41 58 319 2145